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ABSTRACT

To fill an anticipated 25 percent increase in jobs in the machine trades field in the near future, a consortia was formed, with the participants including the El-Tip-Wa Area Vocational School, Indiana Vocational Technical College Region 05, Logansport High School, and the business-community, to produce a local plan for performance-based vocational education (PBVE) in mmachine trades courses. To that end, a local catalogue of performance objectives (i.e., criterion-referenced measures associated with current occupational information relating to the job content of machinists) was established, and a competency-based local model was developed to define the machine trade job cluster. The curriculum, with specialties to match specific machinist jobs from entry level to master, was created. As a result of the project, a new state-approved curriculum was established; community relations between the various groups were cemented; and articulation of students between secondary and postsecondary institutions and between client industries and job trainees was facilitated. (The curriculum guide developed during this project is included in the document.) (KC)

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FINAL REPORT

"Consortia of El-Tip-Wa, Indiana Vocational Technical College - Region 05 Logansport, and the industrial community to develop a local plan for PBVE in Machine Trades"

Dr. Paul Arnold

Project No. 87-78-III-35

Indiana Vocational Technical College Training Center

Logansport, Indiana

September 21, 1981

State Board of Vocational Education

401 Illinois Building

17 West Market Street

Indianapolis, Indiana

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ABSTRACT

A. PROCESS

The machinist developed curriculum used as the central, internally consistent vehicle of the project was approved by Indiana Commission for Higher Education (ICHE) as the Machine Tool Technology Program, and is currently operating and serving the population for which it was originally intended. It continues to operate cooperatively with shared facilities and personnel in the Logansport High School Machine Shop and Indiana Vocational Technical College shared buildings with El-Tip-Wa Area Vocational School, and by supervised on-the-job training in participating industries using prescribed PBVE training units to match specific machinists jobs from entry level to advanced machinist positions with specialties (tool and die, machine repair, trouble-shooter.

B. OBJECTIVES

The two specific objectives of SBVTE grant 87-78-III-35 were accomplished in three planned phases:

Phase I - (a) Development of a machinist curriculum

(b) Establishment of a contract for Logansport High School machine shop use

(c) Training of project personnel in project objectives

Phase II - Establish machinist of PBVE training for full-time trainees with introduction of machinist aptitude and achievement diagnostic test to pace PBVE prescriptions

Phase III - Establishment of criteria reference for machinist training and establishment of PBVE trainee selection groups in each plant, including project director and/or project master machinist

The objectives were:

1. A competency based uni-occupational local model developed to define the machine trade job-cluster within the master of manufacturing for the purpose of curriculum development and program implementation.
2. Develop a local catalogue of performance objectives, criterion reference measures associated with current occupational information relating to job content of machinist.

C. PROCEDURES The project objectives were attained by use of a Program Evaluation Review Technique (PERT) which identified each step to be accomplished along a timed pathway scheduled between November 1, 1976 and March 17, 1981 - inclusive of the project time frame, May 5, 1978 - March 17, 1980.

I. The impacts that have been realized thus far are:

1. A new trade and industrial state approved curricular program regularly operating and enthusiastically used by the population for which it was intended - the general public and client industrial base of Region 05 to develop skills to match job content demands efficiently.
2. The evolvement of a close knit consortia partnership featuring pooled resources in personnel, facilities, and materials which have been non-duplicatively, cooperatively, and economically shared between the Logansport school system, the El-Tip-Wa Vocational Area School and IVTC Logansport Training Center, and client plants in the industrial community for a better training program than any one of the consortia partners could have offered separately.
3. Smoothed articulation of students between the secondary and post-secondary participating institutions and between client industries and their sponsored job-prescribed trainees.

4. "Dovetailing" is a recognized practice between the participating schools in comparable machinist training.

5. Test-out is accepted for institutional credit in the Machine Tool Technology Program wherever applicable.

6. Meeting industrial community needs has been accomplished participatively and cooperatively at the site of training demand and industrial personnel in-put has caused training requirements to be streamlined and realistic.

7. An assessment battery of standardized tests designed to measure machinist skill development against machinist jobs contents, ranging from entry levels to advanced levels, has demonstrated an accuracy and clarity of diagnosis for identifying starting points for prescribed training and the needed emphasis for instructional delivery.

II. Potential impacts on vocational education are:

1. To build upon such prototype approaches as generated by SBVTE grants like 87-78-III-35, a modus operandi in the State of Indiana to:

   a. Use its merged existing vocational education resources to provide training service for new industries establishing in the state, and to offer up-grade and job-transfer training for old industries in the state to overcome obsolescence and to become competitively viable in the market place for the 1980's.

   b. A trend to recognize certifiable work experience for institutional credit in the machinist trades.

INFORMATION SHEET

Project population

Groups	Numbers of persons: Impacted by project	Conducting or giving input
students		
secondary	1600	75
postsecondary	1800	105
adult	6000	267
school personnel		
secondary	19	59
postsecondary	9	9
adult	15500	39
other		
teacher educators	30	12
employers	500	105
employees	10000	312
other:_____		
special needs		
disadvantaged		
handicapped		
migrant		
minority		
limited English proficiency		
other: TRA Trade Readjustment Act (Chrysler)	2000	45

Statement of Objectives

The two agreed upon objectives (listed below) of the State Board of Vocational Technical Education funded project #87-78-III-35 were the instrumental thrusts behind the creation and piloting of a prototype machinist curriculum and delivery system, which effected approval of a two-year post-secondary instructional program in Machine Tool Technology for Indiana Vocational Technical College, Region 05, Logansport Training Center. This state endorsed curricular program for machinists acted as a vehicle for completing successfully phases II and III of the project:

1. To develop a competency-based uni-occupational local model to define the machine trades job-cluster within the major cluster of manufacturing for the purpose of curriculum development and program implementation. (See Exhibit I)
2. To develop a local catalogue of performance objectives, criterion reference measures associated with current occupational information relating to job content for machinists.

(See Exhibits 2, 3 & 4)

Statement of Problem/Purpose

In August 1976, the State Board of Vocational Technical Education approved a grant to conduct a Multi-Community Occupational Needs Survey which identified, within the body of its inquiry, a need for a Machine Trades Training Program in the area to alleviate a crisis demand for skilled workers in the machine trades. The occupational poll further amplified that area industrial groups were falling behind in the skill sophistication required to produce at optimum in many of the highly competitive markets and urgently needed training models to keep apace and forge ahead in the 1980's.

From the above study coupled with current data from the Research and Statistical Section, Indiana Employment Security Division, Indiana Occupational Projections 1976-1982, it was extrapolated that machine trades empl yment needs from entry level to advanced skilled workers would increase twenty-five percent (25%).

As a result of these findings, Indiana Vocational Technical College Region 05, El-Tip-Wa Area Vocational School, Logansport School System, and the Metals Industry Task Force (composed of 17 leading industries) received the funded SBVTE project grant #87-78-III-35, "A Consortia of El-Tip-Wa, Indiana Vocational Technical College, Region 05, and The Industrial Community joined to "Develop a Local Plan for Performance Based Vocational Education (PBVE) in Machine Trades" and fulfilled the following priorities based on the previously stated objectives:

Phase I: To assess local occupational needs for machinists in all categories. (To accomplish between November 1976 - June 13, 1979)

Phase II: To develop and to implement a local operational plan utilizing PBVE in Machine Trades. (To accomplish between September 15, 1978 - June 15, 1979)

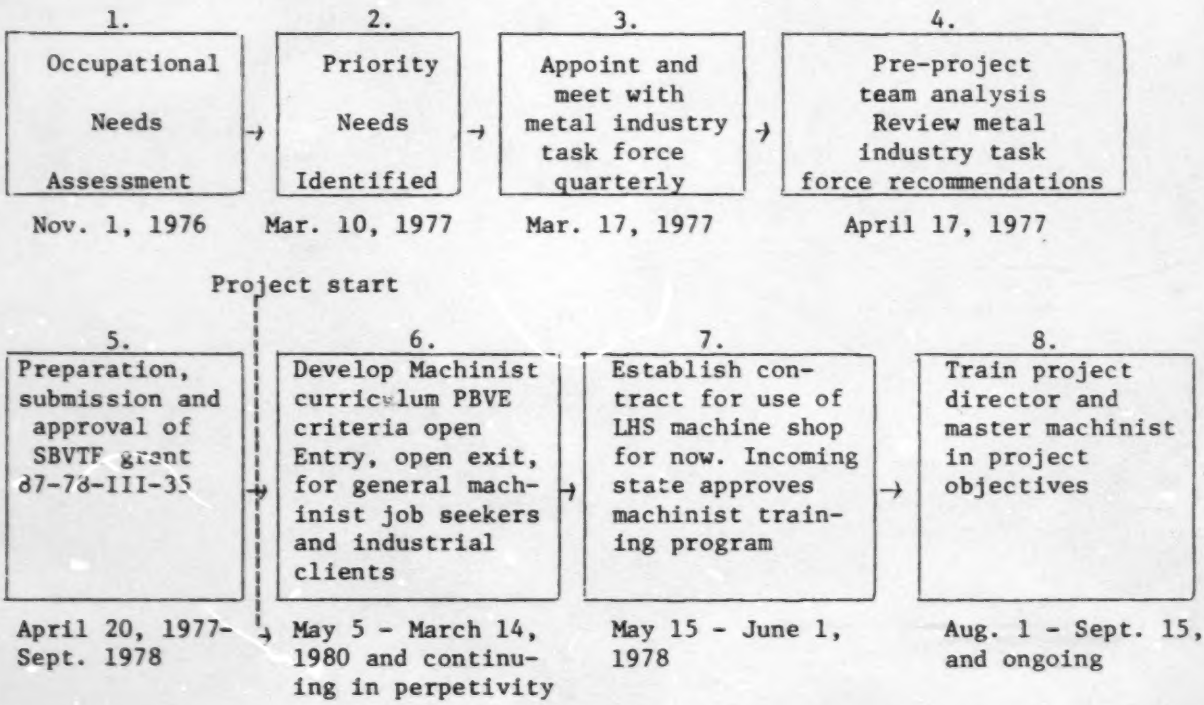
Phase III: To develop and to implement PBVE curriculum materials in Machine Trades. (To accomplish between April 17, 1977 - March 17, 1980, and continued in perpetuity)

STRATEGY/PROCEDURE

Using a revised Program Evaluation Review Technique (PERT) method as agreed by the consortia partners, a time-flow chart was prepared to depict and direct a full-range management matrix of the project to meet its objectives in an orderly and scheduled manner.

Originally, the time factor was denoted by the month only, but it has now been refined tc the actual day of completion or span of start and completion.

PHASE I (November 1976 - June 15, 1979)


1.
Occupational Needs Assessment
Nov. 1, 1976
2.
Priority Needs Identified
Mar. 10, 1977
3.
Appoint and meet with metal industry task force quarterly
Mar. 17, 1977
4.
Pre-project team analysis Review metal industry task force recommendations
April 17, 1977
Project start
5.
Preparation, submission and approval of SBVTF grant 87-78-III-35
April 20, 1977- Sept. 1978
6.
Develop Machinist curriculum PBVE criteria open Entry, open exit, for general machinist job seekers and industrial clients
May 5 - March 14, 1980 and continuing in perpetivity
7.
Establish contract for use of LHS machine shop for now. Incoming state approves machinist training program
May 15 - June 1, 1978
8.
Train project director and master machinist in project objectives
Aug. 1 - Sept. 15, and ongoing

PHASE II

9.	10.	11.
The Machine Tool Technology Program for machinists approved by Indiana Commission Higher Education (ICHE) and SBVTE for Occupational Certificate, Technical Certificate and Associate of Applied Science Degree	Phase I PBVE Training begins with 25 part-time machinist trainees and 32 industrial apprentices for Occupational Certificates and prescription training respectively	Machinist PBVE training begins with 32 full-time Trade Readjustment Act trainers after skill adjustment battery for the machine trade to match skill levels with job content
Sept. 1, 1978	Sept. 15, 1978 - June 15, 1979	March 3, 1980 - February 17, 1981

PHASE III (Evaluation)

This phase underpins, overlaps, and interlocks Phases I and II and maintains a perpetual matching of job skills required to a particular job content match.

12.

(a)	↔	(b)
Establish criteria reference for Machinist Training from both national and local sources through authoritative judgment of each participating industrial plant (17) for their unique skill cluster needs using the quality industrial experience of plant foremen, supervisors, journeyman, plant managers, and the project director and project master machinist with PBVE criteria based against "Selected characteristics of Occupations (Physical demands, working conditions, training time)". 1966 Supplement to the Dictionary of Occupational Titles Third Edition and D.O.T. Machinist Occupational Titles to Local Job Availability in Region 05.		By the formation of an industrial training committee composed of a reference group in each participating plant or agency to select ICS*or TPC**and/or The Machinist Handbook 20th Edition units to match job content of their particular machine trade operational needs. They made individual training prescriptions from their authoritative experience and knowledge of the recipients. In each instance the project director and/or the project master machinist maintained liaison with the designated plant personnel to assure the fit of the training prescription.
May 5, 1978 - March 14, 1980 - and continuing		

*ICS International Correspondence School
**TPC Technical Publishing Company

EVALUATION

Assessment of this project is bottomed on the applied scientific method and the job-fit satisfaction of its users. As such, it is a continuously, on-going appraisal, objectively self-revising program which technically screens dialogue at the interface between experienced, competent in-plant industrialists (i.e., workers, foremen, plant supervisors, engineers, and managers) and capable representative training specialists (project director and master machinist) from the PBVE machinist training consortia, who tailor each training request and refer them back to the PBVE machinist training system, which in turn, exactly and flexibly prescribes the job skill training to match the job content ordered.

Secondly, after meeting rigorous statistical, economic and demographic standards and controls within their New Degree Program Format, the Indiana Commission for Higher Education approved the Developed Machinist Curriculum (Machine Tools Technology) for operation at the Indiana Vocational Technical College Region 05, Logansport Training Center. The above approved curricular program was then, as planned, used as the central internally consistent vehicle upon which Performance Based Vocational Education could be piloted and prescribed uniquely plant-by-plant, and industry group by industry group.

By this means, both of the State Board for Vocational Technical Education project grant objectives were established and continue to operate for machinist training for industrial jobs in Region 05.

Finally, to assure the appropriate beginning point on the PBVE pathway for each individually prescribed client's training and against which class and shop instruction could gauge optimum delivery -- an assessment battery of standardized aptitude and achievement tests especially designed for measuring

machinist skills and work characteristics were assembled and administered to Trade Readjustment Act recipients who had chosen entry into the machinist trade from previous employment with the Chrysler Corporation. The task of the project training component was to prepare them for multiple level entries into new machinists jobs with new skills in the available job market.

After twelve (12) months of training the same group was re-tested and guided to jobs which fit their skills.

Similarly, in shop, progressively more difficult job patterns were laid-out for each client to demonstrate matching skills. At the point where the client could not pass two-out-of-three tries, the first step in the shop prescription began.

EXHIBIT I

STATE OF INDIANA, COMMISSION ON HIGHER EDUCATION
NEW DEGREE PROGRAM FORMAT

Date of Approval & Implementation
September, 1978

MACHINE TOOL TECHNOLOGY

A. PROGRAM DESCRIPTION

1. Statement of objectives of the program.

a. The student will exhibit competency in performing mathematical calculations pertinent to the machine tool industry.

b. The student will demonstrate competency in the mechanical concepts and related technical knowledge common to the machine tool field sufficient to be able to communicate data effectively with individuals knowledgeable in the industry.

c. The student will show evidence of safe, orderly and clean work habits in the shop facilities and work areas at all times.

d. The student will demonstrate awareness of quality control techniques and maintenance of all equipment.

e. The student will demonstrate competence in interpreting technical information in the form of blueprints, electrical and mechanical specifications, tolerances and allowances, formulas and other data expressed in terminology basic to the machine shop.

f. The student will demonstrate skill in diagnosing jobs, then designing and planning the required machine work.

g. The student will exhibit minimum job entry level skills in performing benchwork and metalwork operations common in the machine shop.

h. The student will demonstrate competency at the job entry level in the operation of machines common to the machine tool industry.

i. The student will perform at acceptable levels in all inter-personal relationships with fellow employees, supervisors and subordinates.

2. Description of the proposed curriculum.

a. Degree Requirements

The Machine Tool Technology program results in these certificate/ degree options:

- Occupational Certificate : minimum of 15 credit hours
- Technical Certificate : minimum of 45 credit hours
- Associate in Applied Science : minimum of 106 credit hours

b. Sample Curriculum

Following are these curriculum data:

- The program composition
- A quarter by quarter sequencing of courses
- A listing of course descriptions

MACHINE TOOL

	PROGRAM COMPOSITION	CREDITS
7710	Basic Machine Tool Introduction	3
7731	Basic Print Reading	3
7711	Basic Machining Fundamentals	3
	Math Elective	3-4
8301/8302	Physical Science or Mechanics	3
	Drafting Elective	3
7712	Machining Fundamentals	3
7720	Machine Tool Processing	3
7721	Machine Tool Setup & Operation	3
	Math Elective	3-4
7730	Advanced Machine Tool Processing	3
7733	Advanced Machine Tool Setup & Operation	3
	Machine Elective	3
	Math Elective	4
7734	Advanced Print Reading	3
7740	Specialized Machining Theory	3
7742	Specialized Machine Tool Application I	3
7743	Specialized Machine Tool Application II	3
8112	Technical Communications	3
	Machine Tool Electives	6
	Elective Options - Machining or Tool Design	9
	Elective	3
	Machine Tool Elective	3
8401	Human Relations	4
	Electives	8
8501	Electives and/or Coop. Ed.	15
	Total Credits:	106

ELECTIVES/REGIONAL OPTIONS

	Any Communication courses	
	Any Math or Science courses	
	Any Industrial Management courses	
	Any Drafting Courses	
	Any Welding Courses	
8501	Field Study/Coop Ed	1-15
7331	Electrical Circuits	3
7341	Hydraulics & Pneumatics Fundamentals	3
7741	Basic Heat Treat & Metallurgy	3
7750	Tool Fabrication I	3
7751	Tool Fabrication II	3
7760	Numerical Control & Automatic Proc.	4
7761	Plastics Molding Fundamentals	3
7762	Precision Measurement	3
7763	Grinding Technology	3
7764	Layout & Inspection	3
7770	Practicum	1-15

MACHINE TOOL - CONTINUED

		CREDITS
7331	Electrical Circuits	3
7341	Hydraulics & Pneumatics Fundamentals	3
9415	Mathematics & Blue Print Reading I	4
9424	Mathematics & Blue Print Reading II	4
9433	Mathematics & Blue Print Reading III	4
9412	Shop Mathematics I	3
9421	Shop Mathematics II	3
9431	Shop Mathematics III	3
9441	Shop Mathematics IV	3
9450	Shop Mathematics V	3
9460	Shop Mathematics VI	3
8501	Field Study/Coop Ed.	1-15
7770	Practicum	1-15

MACHINE TOOL TECHNOLOGY

ASSOCIATE IN APPLIED SCIENCE

QUARTER I		C	L	S	CR
7710	Basic Machine Tool Introduction	3	0	0	3
7731	Basic Print Reading	2	2or	3	3
7711	Basic Machining Fundamentals	1	3or	6	3
	Math Elective	4	0	0	4
8301/8302	Physical Science or Mechanics	2	2	0	3
					16

QUARTER II					
	Drafting Elective	1	3	0	3
7712	Machining Fundamentals	1	3or	6	3
7720	Machine Tool Processing	1	3or	6	3
7721	Machine Tool Setup & Operating	1	3or	6	3
	Math Elective	4	0	0	4
					16

QUARTER III					
7730	Advanced Machine Tool Processing	1	3or	6	3
7733	Advanced Machine Tool Setup & Operation	1	3or	6	3
	Machining Elective	1	3or	6	3
	Math Elective	4	0	0	4
7734	Advanced Print Reading	2	2	0	3
					16

QUARTER IV					
7740	Specialized Machining Theory	2	2or	3	3
7742	Specialized Machine Tool Application I	1	3or	6	3
7743	Specialized Machine Tool Application II	1	3or	6	3
8112	Technical Commmunications	3	0	0	3
	Machine Tool Elective				3
					15

QUARTER V					
	Machine Tool Elective				3
	Elective Options - Machining or Tool Design				9
	Elective				3
					15

QUARTER VI					
	Machine Tool Elective				3
8401	Human Relations	4	0	0	4

MACHINE TOOL TECHNOLOGY - Continued

QUARTER VII		C	L	S	CR
8501	Electives and/or Coop. Ed.				15
					15
	Total Credits				108

ELECTIVES/REGIONAL OPTIONS

	Any Communications Courses				
	Any Mathematics or Science Courses				
	Any Industrial Management Courses				
	Any Drafting Courses				
	Any Welding Courses				
7741	Basic Heat Treat & Metallurgy	2	2or 3		3
9416	Basic Diemaking I	3	1	0	3
9425	Basic Diemaking II	3	1	0	3
9417	Advanced Diemaking I	3	1	0	3
9426	Advanced Diemaking II	3	1	0	3
7763	Grinding Technology	1	3 or6		2
7761	Plastics Molding Fundamentals	1	3 or6		2
7750	Tool Fabrication I	1	3 or6		2
7751	Tool Fabrication II	1	3 or6		2
9419	Basic Molding	3	0	0	3
7760	Numerical Control & Automatic Proc.	2	2 or3		3
7762	Precision Measurement	2	2 or3		3
7764	Layout & Inspection	2	2 or3		3
7792	Electrical Circuits	2	2	0	3
7732	Hydraulics & Pneumatics Fundamentals	2	2	0	3
8501	Field Study/Coop Ed	0	0	3-45	1-15
7770	Practicum	0	0	3-45	1-15
9415	Mathematics & Blue Print Reading I	4	0	0	4
9424	Mathematics & Blue Pring Reading II	4	0	0	4
9433	Mathematics & Blue Print Reading III	4	0	0	4
9412	Shop Mathematics I	3	0	0	3
9421	Shop Mathematics II	3	0	0	3
9431	Shop Mathematics III	3	0	0	3
9441	Shop Mathematics IV	3	0	0	3
9450	Shop Mathematics V	3	0	0	3
9460	Shop Mathematics VI	3	0	0	3

COURSE DESCRIPTIONS

The following course descriptions are listed in numerical order. Their sequencing is not intended to indicate the order a student should choose to enroll in them.

7331 INDUSTRIAL MACHINERY ELECTRICAL CIRCUITS 3 credits

Fundamental single phase and three phase alternating current will be studied from the point of parallel circuits, resistance, inductance, switching, fusing, current requirements, transformer applications and motor control. These fundamentals will be applied to typical machinery diagrams through discussion of design, wiring techniques and fabrication of wiring on machines.

7341 BASIC HYDRAULIC AND PNEUMATIC PRINCIPLES 3 credits

The fundamentals of fluid power and the components are covered as to principle, function, terminology and application. Study of machinery circuits is used to make application.

7710 BASIC MACHINE TOOL INTRODUCTION 3 credits

Theory of machine tool processes, introduction to care and use of hand tools, measuring devices, etc. Basic drawing and understanding prints are stressed. Safety features of the lab are also included.

7711 BASIC MACHINING FUNDAMENTALS 3 credits

Simple bench work, sawing, filing, layout, drilling and reaming are utilized toward project completion. Applied mathematics and communications skills are also included.

7712 MACHINING FUNDAMENTALS 3 credits

Introduction to lathe, milling machines, shapers and drill press and the usage is applied to related project assignments.

7720 MACHINE TOOL PROCESSING 3 credits

Fundamental machine shop requirements such as threads and threading, sine bar applications, dividing or indexing head. Lab assignments and sketches are introduced.

7721 MACHINE TOOL SET-UPS AND OPERATION 3 credits

Completed, hardened and ground v-block internal and external threads and usage of the dividing head. Applied mathematics are included.

7730 ADVANCED MACHINE TOOL PROCESSING 3 credits

Non-traditional machining is covered such as H.E.R.F. Laser, E.D.M. and E.C.M., with an introduction to numerical control.

7731 BASIC PRINT READING 3 credits

Machine shop symbols, stock lists, shop blueprints are interpreted relative to dimensions, shapes, fabrication and assembly. Basic mathematics is applied in solving print and performane problems.

7733 ADVANCED MACHINE TOOL SET-UP AND OPERATION 3 credits

A continuation of tool processing. Completed 5" sine bar and assembly; special emphasis on surface and cylindrical grinding. Applied mathematics are included.

7734 ADVANCED PRINT READING 3 credits

Mathematics is applied in solving shop problems related to die design and fabrication, special machinery, die casting, etc. Assembly drawings are interpreted and the ability to make sketches without shop instruments are included. A simple motion device or progressive die will be designed.

7740 SPECIALIZED MACHINING THEORY 3 credits

Introduction to jig boring and grinding and procedures are stressed. Rotary table, tracing practices, advanced machine tool processes in varied areas, including special projects, utilizing specialized machine tools.

7741 BASIC METALLURGY AND HEAT TREATMENT 3 credits

The fundamentals of thermodynamics and reactions that occur in metals subjected to various heat-treatment methods and techniques. Utilization of gas and electric furnaces and their controls are covered. Heat treatment principles as applied to ferrous and non-ferrous materials are covered. Properties of metals and tests to determine their uses. Chemical and physical metallurgy. Theory of alloys. Treatment for steels, special steels and cast iron. Power metallurgy. Classification of metals. Applied mathematics and communication skills are also included.

7742 SPECIALIZED MACHINE TOOL APPLICATION I 3 credits

Application of jig boring and grinding studies is applied to advanced project completion. Math skills included.

7743 SPECIALIZED MACHINE TOOL APPLICATION II 3 credits

Application of differential indexing, gear cutting and cam milling. Tracer design and application applied to project completion. Required mathematics are included.

7750 TOOL FABRICATION I 3 credits

A study of accepted tool design, assembly, and standards. Basic blanking and piercing dies, their operations and components are stressed.

7751 TOOL FABRICATION II 3 credits

In this course the student develops acquired knowledge of progressive dies, transfer of motion and force. Fabrication and designing skills will be demonstrated toward assigned project completion.

7760 NUMERICAL CONTROL AND AUTOMATIC PROCESSING 3 credits

Introduces the concept of automatic process control. Fundamentals of feedback elements, transmission, control action, controlling elements as used in pneumatic, hydraulic and electrical systems. Special emphasis is placed on the relationship between digital devices and the automatic process control system; the special tooling techniques required; the programming of tape controlled machines; and the applied mathematics re-

7761 PLASTICS MOLDING FUNDAMENTALS 2 credits

This course is a study of the basic materials and processes used in plastics technology. The study includes types of mold tools, plastic composition, basic injection mold design and the machines and methods used to produce various plastic products with emphasis on injection molding methods.

7762 PRECISION MEASUREMENT 3 credits

This course demonstrates the process for linear and angular measurements, methods and techniques of applying precision measurements to the varied machine tool applications, including production and quality control.

7763 GRINDING TECHNOLOGY 2 credits

This course is designed to allow students the opportunity to become familiar with and proficient in the industrial application of grinding. Students will perform such operations as contour and radius grinding. Students will be able to set and dress designed internal and external radius to within .005" with 90 percent accuracy. Classwork will involve the identification of abrasives and the structure of grinding wheels and their proper care and usage.

7764 LAYOUT AND INSPECTION 3 credits

The student demonstrates a skill of various layout materials and instruments. Interchange ability is considered in relation to inspection procedures. Applied mathematics is also included.

7770 PRACTICUM 1-15

A variable credit lab or shop course designed to provide extended practice and skill development opportunities directly related to one or more specific courses.

8112 TECHNICAL COMMUNICATIONS 3 credits

This course is designed to help students achieve competence in listening, speaking, reading and writing with the emphasis on writing.

8301 PHYSICAL SCIENCE 3 credits

Emphasis in this course is on energy sources and energy transformations; the use of energy is related to its effects on the human population and the enviroment. (For certificate and associate degree programs.)

8302 MECHANICS 3 credits

This course is a study of machines and mechanisms with regard to their stability, movement, effectiveness and construction.

8401 HUMAN RELATIONS 4 credits

This course concerns the qualities and characteristics which make us human. The course involves study of human behavior, motivation, relationships, and the human aspects of work. Emphasis is placed on personal awareness and application of concepts studies.

8501 FIELD STUDY/COOP ED 1-15

The student will be given a special project or case study specifically related to the occupational area. The course should be a field project within the framework of actual working experience in business or industry or a research type case study including data collection and data analysis.

9412 SHOP MATHEMATICS I 3 credits

Consists of review including addition, subtraction, multiplication and division of whole and mixed numbers; covers fractions, decimals and percentage; uses practical industrial shop problems wherever possible.

9415 MATHEMATICS AND BLUEPRINT READING I 4 credits

In this course the student is introduced to the basic study of mathematics in the machine tool area. The study includes fractions, decimals, equations, squares, square roots, distances, areas, and volumes, all of which are interpreted from various drawings, sketches and prints.

9416 BASIC DIE MAKING I 3 credits

A study of accepted tool design, assembly, and standards. Basic blanking and piercing dies, their operations and components are stressed.

9417 ADVANCED DIE MAKING I 3 credits

Continuation of Basic Die Making II. This course is to familiarize students with multiple stage, progressive and transfer dies. This involves critical assembly, feeding devices and critical timing.

9419 BASIC MOLDMAKING 4 credits

Covers composition and characteristics of various plastics materials, studying design factors of compression, transfer and injection molds along with mold components, heating and cooling principles and application as applied to designing and maintaining a functional mold tool.

9421 SHOP MATHEMATICS II 3 credits

Includes lineer and square measure, volumes, square roots, ratios and proportions, and an introduction to algebraic functions, sined numbers, grouping and axioms using practical shop math whenever possible.

9424 MATHEMATICS AND BLUEPRINT READING II 4 credits

This course is a continuation of Mathematics and Blueprint I. Introduction to basic algebra, equations, factoring and Plane Geometry. The metric system will also be stressed.

9425 BASIC DIE MAKING II 3 credits

A continuation of basic die making. More involved die making techniques and terminology are included. Emphasis of basic multi-slide die, cam operation etc., are stressed. Assembly practices, stripping action are also covered.

9426 ADVANCED DIEMAKING II 4 credits

Studies more elaborate and involved than Basic Diemaking; including diemaking, draw dies, secondary operations, trim, notch, and shear dies.

9426 ADVANCED DIEMAKING II 3 credits

Studies more elaborate and involved than Basic Diemaking; including die-forms, draw dies, secondary operations, trim, notch, and shear dies.

9431 SHOP MATHEMATICS III

Covers addition, subtraction, multiplication and division of monomials and polynomials, equations, factoring, fractions, fractional and literal equations, exponents and radicals, linear equations and quadratics using shop mathematics whenever possible.

9433 MATHEMATICS AND BLUEPRINT READING III 3 credits

Knowledge of techniques are broadened by use of descriptive geometry involving points, lines, surfaces and solids. Particular emphasis is placed on trigonometry of right and oblique triangles determined from various prints.

9441 SHOP MATHEMATICS IV 3 credits

Studies definitions and descriptions of geometrical terms, axioms and theorems, explanations regarding propositions dealing with straight lines, triangles and circules, and applications to practical shop problems.

9450 SHOP MATHEMATICS V 2 credits

Includes definitions of the trigonometric functions, construction and use of tables, interpolation solutions of right triangles, and applications of trigonometry to practical shop problems; also, computations made with logs and functions of the angles.

9460 MATHEMATICS VI 3 credits

Covers obliques by altitude construction method, laws of sines, cosines and co-tangents, ½ angle formula and tangent law, with emphasis on shop and shop design type problems.

3. Description of unusual program features.

a. Innovative features.

The intended site of this program is Logansport and Cass County and will be the first Region 5 curriculum requested primarily for this area. While some students are anticipating commuting to this location, the Cass County industrial base can provide sufficient support to justify it, particularly in view of the modest expense of operating this normally high-cost program. (See "b" below for amplification of the Logansport High School/ IVTC-Kokomo cooperative effort.)

The Machine Tool Technology program is so designed as to provide multiple entry and multiple exit opportunities to students, thus allowing them to become employable quickly. Furthermore, the easy accessibility of the program provides a means of recognizing prior skills and for those currently employed, the chance to enroll in courses for upgrading and retraining purposes.

b. Joint ventures with other parties.

In August, 1977, IVTC-Kokomo entered into an agreement with the Superintendent and the Board of Education of Logansport High School that provides for joint use of the high school facilities (see attached agreement). Costs of supplies, utilities, custodial services and normal maintenance are to be the only costs borne by the college.

The program will be operated in the well equipped machine shop of the high school during the evening hours and on Saturdays. This time restriction will not pose a hardship to students of the college, since the target population is essentially from the already-employed members of the community.

The machine shop department at the high school has been approved by the U.S. Department of Labor, Bureau of Apprenticeship as meeting their standards for machine trades training. A detailed listing of equipment and available floor area is attached.

4. Faculty and administrators directly involved.

Dr. Jerry G. Solloway	Vice President/Dean
Paul Arnold	Director of Extended Services
Charles Orem	Director of Student Services
William Thompson	Director of Instruction

The faculty members to be directly involved with coordinating and teaching duties will be named at a later date.

B. PROGRAM RATIONALE

1. Student Factors

a. Magnitude of Demand (see Attachment 2)

This program request is, to a large extent, a response to interest expressed by students presently enrolled at IVTC-Kokomo. Through special course approval, selected courses from this curriculum have been offered since Fall 1977, resulting in over 100 students. This group is employed in regional industry and has indicated an interest in upgrading its employment potential. Students from Kokomo are currently traveling to Logansport to receive instruction in certain of these courses. This student interest, coupled with the industrial support revealed by surveys and communications in the Logansport area indicate an immediate need for such training.

b. Source of Students

1) Geography

IVTC-Kokomo serves the six counties of Cass, Fulton, Miami, Howard, Tipton and Wabash. Cass and Howard counties constitute the most significant counties, in terms of population (54% : 1975) population growth and employment. The two counties adjoin, with the two metropolitan centers (Logansport and Kokomo) located within easy commuting distance of each other. Therefore, the bulk of students are expected to originate in these two geographical areas. However, the scarcity of machine trades training opportunities throughout Region 5 will bring in students from other counties, as well.

2) Type

The experience gained since Fall, 1977 with the limited course offerings from the Machine Tool Technology curriculum (see B.I. a. - Magnitude of Demand) suggests strongly that most students will enroll for this program only. This program shares few features with other IVTC programs and thus, provides access to a population not accomodated previously.

Through the efforts of a recently developed Office of Extended Services, the projected headcount in Machine Tool Technology is in the range of 8-12% of the total for Region 5.

c. Student Needs

The availability of machine trades training at the post-secondary level in the Region 5 area will open a door to the skilled trades to individuals currently barred admission. The disadvantaged persons that have experienced difficulty gaining admittance to this lucrative field will find an opportunity unknown before.

2. Marketplace Factors

a. Employment

In a recent study undertaken by the Indiana Employment Security Division, among the occupations found to be in constant demand in Region 5 during 1977-78, and the future, are the following:

machine tool operators
machine tool setters
machinists
millwrights
tool and die makers

Statistical data for all the above occupations is incomplete at this time. However, for selected job categories, the anticipated growth has been documented by the Indiana Employment Security Division as being quite high. The total job openings between 1970 and 1980 expressed as a number and a percentage for certain occupations is as follows:

	NO. OF OPENINGS	% OF 1970 EMPLOYMENT
Job & diesetters, metal	175	30%
Machinists	197	20
Millwrights	57	19
Tool, Diemakers	139	12
Tool, Diemaker Apprentice	9	14
Metalworking Operative, Semi-skilled	1,560	26
Drill Press Operatives	61	26
Grinding Machine Operatives	240	29
Lathe & Milling Machine Operatives	123	21
Other Precision Machine Operatives	129	33
Punch Stamping Press Operatives	306	24
Total	2,996	

NOTE: The above information is only available for Regions 4 and 5 combined. The trends depicted here are considered to be applicable to each region, however.

In mid-1977, an informal needs assessment survey was conducted by a task force made up of administrators of Logansport Community School, El-Tip-Wa Vocational School and IVTC-Kokomo. The survey concerned itself with the present and future employment needs of the six largest industries in Logansport and asked, among other things:

a. How many additional tool and die apprentices are scheduled for training in the next five years?

   Answer: 84

b. Is your company in a position to provide machine stations for training purposes?

   Answer: No (by all employers)

MACHINE TRADES DEPARTMENT

(AVAILABLE TO IVTC-KOKOMO - LOGANSPORT HIGH SCHOOL - LOGANSPORT, INDIANA)

1. Total square footage: 8,000

2. Equipment List:

QUANTITY	ITEM	BRAND
15	Lathes W/quick change gearboxes	South Bend
2	Lathes - Large	South Bend
1	Shaper-Small	South Bend
3	Shapers-Large	South Bend
1	Horizontal Milling Machine	Cincinnati
1	Horizontal Milling Machine	Given
1	Horizontal Milling Machine	Foreign Make
1	Vertical Milling Machine	Bridgeport
1	Surface Grinder	Boyer-Schultz
1	Surface Grinder	K.O. Lee
1	Tool Grinder	K. O. Lee
2	Drill Presses	Rockwell
1	Drill Press	Powermatic
1	Vertical Belt Sander	Rockwell
2	Automatic Power Filers	Keller Die
1	Snag Grinder	Black & Decker
1	Snag Grinder	Rockwell
2	Bit Grinders	Rockwell
1	Vertical Band Saw	Powermatic
1	Vertical Band Saw	Duvall
1	Horizontal Band Saw	Kaiser-Johnson
1	Electro-Discharge Machine	EDM
1	Arbor Press	South Bend
12	Bench Vises	Various Makes

Courses Only Activity in Machine Tool Technology,

Fall and Winter Quarters, 1977-78:

7710	Basic Machine Tool Introduction
7731	Basic Print Reading
7711	Basic Machine Fundamentals
7763	Grinding Technology
7751	Tool Fabrication I
7729	Machine Tool Processing
7762	Precision Measurement
7712	Machining Fundamentals
7770	Practicum
7760	Numerical Controls and Automatic Procedures

Potential Maximum Capacity

MACHINE TOOL

- 2 courses per evening of shop and related work in Machine Tool courses
- 3 credit courses or the average at 2 hours of class and 2 of laboratory at 4 contact hours.
- 5 evenings and double sessions on Saturdays =

  7 time frames for scheduling courses, or

  14 potential courses per week
- Potential of 2 additional 4-credit non-shop courses per week such as mathematics, science, human relations, etc.
- One FTE = 15 credits: maximum enrollment of 25 per course
- $\frac{14 \times 25 \times 3}{15}$ = 70.4 FTE per quarter

  $\frac{2 \times 25 \times 4}{15}$ = 13.3 FTE per quarter
- 70.4 + 13.3 = 83.7 FTE potential per quarter
- 83.7 x 4 quarters = 334.8 FTE per year

Statewide Enrollment

Machine Tool Technology

Fall, 1977-78

	Headcount
Region 02	130
Region 03	105
Region 04	5
Region 06	100
Region 08	140
Region 09	68

SUMMARY INFORMATION OF NEEDS ANALYSIS JUSTIFYING THE ESTABLISHMENT OF INDUSTRIAL MAINTENANCE AND MACHINE TOOL TECHNOLOGY PROGRAMS FOR THE SERVICE AREA OF IVTC REGION 5:

I. The consortia study conducted by El-Tip-Wa Area Vocational School and IVTC region 5, indicated a strong interest and need to support Machine Trades classes.(See pages 7 & 8, and page 10- item #1).

II. Buttressing interviews in-depth with Cass county members of the Metal Industry Task Force (Presidents, General Managers, and Supervisors) , elicited a strong willingness to provide machinery and other equipment for training stations,and the intention to financially support their personnel in Machine Tool Trades. (see page 2).

III. A random stratified sampling representative of the (500) industries based in our service area expressed an urgent need for (402) employees to be trained in the machine trades. (Machine Tool and Industrial Maintenance Technology). An extrapolated figure, based on this representative sample, would suggest the potential of, in excess of 1,000 people in training annually.

(1) Currently, operational courses show (55) apprentices in; Tool & Die, Machine Repair, and Millwright, taking approved courses in Industrial Maintenance and Machine Tool Technology.

(2) There are (45) pre-apprentices taking related studies and machine shop training (using the federally approved machine shop, at Logansport High School). The above pre-apprentices, are sponsored by companies of the IVTC, Region 5 Metal Industries Task Force.

(3) Fifteen (15) of the twenty-three (23) predominant trade areas in region 5, are taking related courses featuring some aspect of course offerings in Machine Tool Technology and/or Industrial Maintenance.

(4) Combined advisory committees, composed of industrial management, union leadership and contractors, strongly support the advancement of machine trade courses featuring Industrial Maintenance and Machine Tool Technology from data collected Region 5.

Dr Paul Arnold

In American Industry, there is a saying that a company either grows or [illegible]. As you think of your own company's good health, what are its most critical needs?

Elco: Company is growing - new plant construction to start in July. Expect to double business in next five years. Most critical need presently is 23-25 tool and die makers.

Small Parts: The need to motivate toward our particular needs and industry. To provide self-respect. To develop skills necessary to meet tomorrows needs. Flexibility and planning for tomorrow.

Switches: Qualified people - increased sales.

Essex: Tool and die people

General Tire: Qualified manpower

Rockwell: Overcoming obsolescent equipment and skills and improving the quality of the trade skills available.

1. What is your current employment base?

Elco	- 126	Small Parts	- 175
Switches	- 450	Essex	- 1100
General Tire	- 476	Rockwell	- 400

2. Of the total number of employees, how many are involved in production work?

Elco	- 56	Small Parts	- 75
Switches	- 300	Essex	- 900
General Tire	- 375	Rockwell	- 280

3. Of the total number of employees, how many are skilled tool and die workers?

Elco	- 24	Small Parts	- 40
Switches	- 8*	Essex	- 15
General Tire	- 19*	Rockwell	- 8*- 2 apprentices

*To remain constant)

4. In your [illegible], how many additional employees do you plan to hire over the next five years?

Elco	- 20	Small Parts	- 25
Switches	- 24	Essex	- 14
General Tire	- 70	Rockwell	- 100-150 (replacement only)

5. Of this number, how many additonal tool and die apprentices are scheduled for training in the fiscal year -

	1977	1978	1979	1980	1981
Elco -	5	9	12	--	--
Small Parts -	8	--	--	--	--
Switches -	10	11	1	1	1
Essex -	3	3	2	3	3
General Tire -	2	2	2	2	2
Rockwell -	2	--	--	--	--

6. As a joint participative effort, is your company is a position to provide machine stations for training purposes?

	Yes	No
Elco		x
Small Parts		x
Switches		
Essex		x
General Tire		x
Rockwell		x

Remarks:

Elco: Has machinery to use at another location.

Small Parts: Prefer central location - will donate machinery

Switches: Prefer central location - will provide machinery

Essex: Are sure they can sell program to Essex people and be able to provide machinery outside of plant.

General Tire: Prefer central location - will provide euipment at later date.

Rockwell: Prefer central location - will contribute equipment

7. As you look at the Training Guide, which of the areas are most [illegible] for your training purposes.

	Related Subject Classroom Instruction	On the job [illegible] training coordinator provided to regularize instructional practices and procedures
Elco	x	x (Precision Tools)
Small Parts	NA	NA
Switches	x	NA (Electronics)
Essex	x	x
General Tire	x	x
Rockwell	x	x (Maintenance personnel)

8. Can you suggest ways in which members of your organization might work in the community and its schools to provide stimulating exposures toward trade and industrial careers.

Elco: Trade Fair - tour of plant

Small Parts: Plant tours - start with teachers - familiarize them with tool and die industry.

Switches: Small group exposure from schools (7,8,9,10 grade)

Essex: Put a program together to show young people what the tool and die business is about.

General Tire: Presently working with economics class at Logansport High High School. 5 week program; tour of plant - people from plant to go to the classrooms each week - give history of respective plants, product, payroll, tax structure, how product is sold. Union President to explain how organized labor works.

Rockwell: Involved in same program as General Tire and Switches.

9. In a participative way, how may we work with the young in generating positive values about the "Free Enterprise System" - its preservation and advancement and the important roles to play in it.

Elco: Make young people aware of what is available - opportunity is here - Elco is interested in exposing these jobs to high school students.

Small Parts: Know it is important, but how do we do it. Referred group to clipping from newspaper - "Those Myths About Profit"

Switches: Very important, but doesn't know how to answer - Motivation

Essex: We need to teach them the value of "Free Enterprise System" but [illegible] People feel they are doing the company a favor by coming to work instead of realizing their potential is. It seems they are more interested in 'gimme' gimme' 'gimme'.

Returns from a "Questionnaire" of a needs analysis questionnaire based on a random, stratified, representative sampling technique of (500) Industries in IVTC-Region 5 service area of Fulton, Cass, Miami, Howard, Wabash, and Tipton counties.*

* Although Industrial Maintenance was the central feature of this study, in-depth course requirements were also experssed for "Machine Tool Technology", a companion program.

QUESTIONNAIRE

Your answers will help serve you better!

PLEASE COMPLETE AND RETURN AS SOON AS POSSIBLE

FROM THE 37 AVAILABLE INDUSTRIAL MAINTENANCE TRAINING SUBJECTS (LISTED ON THE OPPOSITE SIDE) YOUR COMMITTEE HAS SELECTED THE CURRICULUMS SHOWN BELOW. NOTE THAT WE HAVE PURPOSELY OMITTED THE BASIC SUBJECTS SUCH AS MATH, TOOLS, BLUEPRINT READING, ETC, ETC. IF YOU FEEL NEED FOR TRAINING IN THESE AREAS BE CERTAIN TO ANSWER QUESTION #4. IF THERE IS ENOUGH INTEREST WE WILL MOST CERTAINLY CONSIDER OFFERING AN ADDITIONAL COURSE, TO BE CALLED "INTRODUCTION TO INDUSTRIAL MAINTENANCE." THIS COURSE WOULD BE PREREQUISITE TO THE ELECTRICAL MAINTENANCE AND THE MECHANICAL MAINTENANCE COURSES. YOUR ANSWERS TO ALL OF THE FOLLOWING QUESTIONS WILL BE A GREAT HELP TO US IN OUR PLANNING. THANK YOU IN ADVANCE FOR YOUR COOPERATION. WE APPRECIATE IT!!

MECHANICAL MAINTENANCE TRAINING COURSE

1 - Elements of Mechanics
2 - Lubrication
3 - Drive Components
4 - Bearings
5 - Pumps
6 - Piping Systems
7 - Basic Hydraulics
8 - Hydraulic Troubleshooting
9 - Basic Pneumatics
10 - Pneumatic Troubleshooting

ELECTRICAL MAINTENANCE TRAINING COURSE

1 - Intro. to Electricity & Electronics
2 - Batteries & D-C Circuits
3 - Transformers & A-C Circuits
4 - Electrical Measuring Instruments
5 - Electrical Protective Devices
6 - D-C Equipment & Controls
7 - Single-Phase Motors
8 - Three-Phase Systems
9 - A-C Control Equipment
10 - Electrical Troubleshooting

QUESTION 1 Do you approve of the tentative curriculums shown above? YES NO (CIRCLE ANSWER)

QUESTION 2 If you DO NOT approve, please jot down your suggestions for improvement _____

_____

_____

_____

QUESTION 3 Would you like to have us offer a third course covering the basic subjects? This course will be called "INTRODUCTION TO INDUSTRIAL MAINTENANCE." YES NO (CIRCLE ANSWER)

QUESTION 4 If your answer to Question #3 was YES, what subjects should be included in the course? _____

_____

_____

QUESTION 5 How many of your maintenance men need training? In Mechanical Maintenance..... _____

In Electrical Maintenance..... _____

In the Basics (the course mentioned in Question 3)..... _____

YOUR NAME _____ TITLE _____

PARENT COMPANY _____

DIVISION _____

STREET ADDRESS _____

CITY _____ ST. _____ ZIP _____

Our new Industrial Maintenance Training Courses will be developed from the 37 subjects listed below. Each course will contain 10 subjects. Each subject is thoroughly covered in a series of 10 individual lessons. This page contains a brief description of what the trainees will learn in each subject area. Use this information as a guide when making suggestions in regard to the tentative curriculums shown on the questionnaire.

ELECTRICAL SUBJECTS

INTRODUCTION TO ELECTRICITY & ELECTRONICS. Basic, nonmathematical approach to understanding principles of electricity. Introduces electron theory, static electricity, electrons in motion, and magnetism. Covers basic method of generating a voltage—measuring current, voltage, resistance. Explains circuit components—conductors, insulators, resistors, capacitors. Simple Ohm's Law calculations for D-C and A-C circuits.

D-C CIRCUITS. How electrochemical action is used, batteries, electrolytic action, electroplating. Characteristics of storage batteries. Application and maintenance of lead-acid, nickel-alkaline, and nickel-cadmium batteries. Putting batteries into service, charging, and maintaining records. Explains fundamentals of D-C circuits, using Ohm's Law to solve problems in D-C series, parallel, and series-parallel circuits.

A-C CIRCUITS. Shows differences between D-C and A-C circuits. Explains A-C sine wave, using vectors to solve A-C problems. Solving the impedance formula with inductance (inductive reactance) and capacitance (capacitive reactance). A-C power relationships in single-phase and three-phase circuits. Principles of transformer maintenance.

MEASURING INSTRUMENTS. Explains the principles on which electrical test instruments operate. D-C instruments covered include voltmeter, ammeter, wattmeter. Use of ohmmeter and megohmmeter, A-C metering, split-core ammeter, using current and potential transformers. Covers broad range of special instruments including watthour meters, bridge circuits, indicating and recording instruments, oscilloscopes and other electronic instruments.

PROTECTIVE DEVICES. Covers full range of devices used to protect conductors and equipment from excessive electrical current, high and low voltage, grounds. This includes fuses, circuit breakers, and overload relays. Explains National Electrical Code as it applies to grounding, terminal identification, conductors, conduits. Also covers industrial illumination and maintenance and safety practices.

D-C EQUIPMENT & CONTROLS. D-C power applications in industry. Types of D-C generators. Operating characteristics of D-C motors. D-C armature principles, armature maintenance and repair. Types of D-C relays, D-C controllers, overspeed and overload protection. Drum controllers, reversing controllers, dynamic braking. D-C power supplies, diodes, semiconductors, SCR principles, D-C maintenance practices.

SINGLE-PHASE MOTORS. Types and operating principles of all common single-phase motors. NEMA motor standards. Explains how to identify motor leads on split-phase, capacitor-start, capacitor-run, permanent-split capacitor and repulsion motors. Also covers universal motors, shaded-pole motors, synchronous motors, and other special types including synchro and servo systems. Gives general maintenance procedures on all single-phase motors.

POLYPHASE SYSTEMS. Explains polyphase motor principles for induction motors, synchronous motors, and multiple-speed, dual-voltage motors. Gives recommended maintenance practices for large A-C motors. Principles of polyphase motor starters, including part winding, start, reversing, jogging. Alternator principles and operation. Describes polyphase power distribution systems.

A-C EQUIPMENT & CONTROLS. Covers the broad range of industrial motor starting and control equipment. NEMA sizes and ratings. Includes pushbutton control stations, limit switches, mercury switches, mechanical and magnetic plugging, foot switches, pressure, temperature, and float switches. Special applications, including timers, counters, control, and sequencing relay systems. Control panel wiring.

ELECTRICAL TROUBLESHOOTING. Proper use of schematic diagrams, determining sequence of operation. Using building diagrams, single-line diagrams. Step-by-step troubleshooting procedures for control circuits, combination starters, and other control devices. Maintenance and troubleshooting practices on D-C and A-C motors. Identifying unmarked leads on three-phase delta and wye connected motors. Troubleshooting lighting systems, and reducing troubleshooting time.

MECHANICAL SUBJECTS

ELEMENTS OF MECHANICS. Work and energy, forces and motion as applied in industrial maintenance. Principles of operation for simple machines such as levers, inclined plane, wheel and axle, pulley, and screw. Shows how to make simple calculations to determine useful work, and mechanical efficiencies—also measurement, area and volume. Covers working with hand tools, power tools, and fasteners.

LUBRICATION. Complete lubrication training program, covering functions of lubricants, lubricant characteristics, selection, effects of additives. Bearing lubrication. Types of oils and their application. General purpose and special purpose greases. Other types of lubricating compounds. Lubrication methods and automatic lubrication systems. Proper handling and storage methods.

DRIVE COMPONENTS. Covers commonly used mechanical couplings plus special couplings such as shear, torque limiting, floating, electrically insulated. Also includes wide variety of clutches, V-belt drives, and chain drives. Application, installation, and maintenance of various speed reducers. Gears such as spur, helical, and worm. Installation and maintenance of brakes and motors.

BEARINGS. Principles and applications of various types of bearings including plain journal bearings, ball and roller antifriction bearings. Explains installation, inspection and repair, or replacement of bearings. Contained bearings

MECHANICAL-CONTINUED

including powdered-metal bearings, nonmetallic bearings, hydrostatic bearings. Covers bearing seals, lubrication, and maintenance practices.

PUMPS. Typical applications of various types of pumps. Factors affecting pump selection. Describes and explains operating principles of centrifugal, propeller & turbine rotary, reciprocating, and metering pumps. Special purpose pumps including diaphragm pumps and others designed to handle corrosive and abrasive substances. Covers pump maintenance, packing gland, seal, and bearing replacement.

PIPING SYSTEMS. Piping systems, valves, fittings, hangers, supports, insulation. Metal and nonmetallic piping. Pipe joining methods. Tubing—how it is sized, where it is used. Fitting, bending, and joining. Use of hoses, and fittings. Common and special valves, steam traps, filters, strainers. Piping system accessories and general maintenance requirements.

BASIC HYDRAULICS. Hydraulic principles, types of hydraulic fluids and their characteristics. Components of the hydraulic system and their function including filters and strainers, reservoirs and accumulators, pumps, piping, tubing, and hoses, control valves, relief valves, and actuating devices. Covers wide variety of cylinders and hydraulic motors.

HYDRAULIC TROUBLESHOOTING. Understanding the system. Using schematic diagrams. Proper installation procedures, cleanliness, and safety. Tubing cutting, bending, and flaring practices. Identification and selection of proper fluid, and charging the system. Planned system maintenance, specific troubleshooting recommendations on system diagnosis, and troubleshooting valves, cylinders, pumps, and motors.

BASIC PNEUMATICS. Shows how work forces, and energy are applied to principles of pneumatics. Covers operating principles of reciprocating, positive displacement, rotary, and dynamic air compressors. Primary and secondary air treatment, including moisture removal, air scrubbers, contaminant filtration, and lubrication. Components include valves, logic devices, cylinders, and air motors.

PNEUMATIC TROUBLESHOOTING. Overview of pneumatic system. Use of schematic symbols and diagrams. Proper installation of system components. Planned maintenance of a pneumatic system. System diagnosis, and step-by-step troubleshooting recommendations for system components including air compressors, control valves, electrical components and air motors. Specific practices for pneumatic/hydraulic systems.

INTRODUCTION TO PACKAGING. Explains the job of the packaging mechanic. Provides detail on all types of packaging machinery to help in solving problems. Covers various mechanical drives, couplings, motors, brakes, variable speed drives, clutches, electrical controls, motor starters sequence controls, time delays, relays. Packaging specifics include types of materials, methods of filling, methods of sealing, weights and volumetric measurement.

CASING MACHINERY. This unit explains the operating characteristics and service techniques of accessory or auxiliary machines used with packaging lines. It describes the general operating characteristics of labeling equipment; uncasing, unscrambling, and cleaning machines; gluing equipment and adhesives; wrapping machines; tying, strapping, and stitching machines; and shrink wrapping devices.

PACKAGING MACHINERY. The equipment explained in this unit relates to the more sophisticated machinery found in packaging operations. It includes information on package sorting and palletizing machinery, conveyors and elevators, washing and sterilizing machines, counting devices, product inspection devices, and container extruding, molding, and forming machines.

UNDERSTANDING INDUSTRIAL POLLUTION CONTROL. Thorough r explains the various types of industrial pollution problems; air, water, solid waste and noise. Teaches acceptable control methods. Trainees learn about the basic equipment used for industrial pollution control. How to detect and measure pollution. The unit contains sections on ventilating, removal, physical separation, oxidation, digesters, effluents, tailings, bottom ash, slag, sludge, dusts of various origin, sound transmission, suppression and absorbants. Trainees who successfully complete this introductory unit will have a solid understanding of the basics of industrial pollution causes and control.

BASIC SUBJECTS

BASIC BLUEPRINT READING. Covers all types of blueprints found in industrial maintenance. Shows how things look on a print. Introduces conventions used. Includes machine, building, electrical, piping, and sheetmetal drawings. Also shows how to compute dimensions off a print using basic shop math, and how to sketch out ideas using techniques applied to engineering drawings.

READING SCHEMATICS AND SYMBOLS. Shows systems and how they work. Covers primarily electrical and fluid power diagrams, as well as welding symbols. Provides an important first step to troubleshooting. Teaches an understanding of how symbols are developed and what they mean. Symbols are then put together to form components, and finally, complete systems.

BASIC SHOP MATH. Explains the use and meaning of numbers, fractions, decimals, percentage and exponents. Covers the practical uses of mathematics for making calculations in the shop as needed in day-to-day work schedules. Practical approach to working with formulas and equations. Basic algebra, and trigonometric functions are explained, along with practical problem-solving techniques.

BASIC-CONTINUED

MEASUREMENT. Units of measurement, metric measurement and methods of measuring are covered in this unit. Measurement of bulk materials, motion, fluid, force, temperature and basic electrical measurements are explained in this unit to impart knowledge of the more common measurements made in industrial operations. The basic devices and equipment used to make these measurements are also described.

METAL MATERIALS. Physical structure of metals and their alloys. Malleability, ductility, toughness and elasticity. Machineability of metals, properties of metals, stress-tension, elasticity, metal fatigue, usable strength of metals, metal expansion, heat and temperature. Manufacturing processes, casting, principles of heat treatment, hardening, tempering, and annealing, iron and iron ore, types of cast iron. How steel is produced, steel classifications, steel color code, alloy steels and effect of alloying elements. How aluminum is produced and its uses, fabricating methods, aluminum alloys. Magnesium and titanium, refining processes, alloying and uses. Producing copper and uses of copper and copper alloys. Lead, nickel, tin and zinc: their properties and uses in industry.

NONMETAL MATERIALS. This unit explains the composition, structure and properties of nonmetal materials. Hydrocarbons and polymers, plastics, and polyvinyl materials. Thermosets and their uses. Rubber and other elastomers used in industry. Protective coatings, paints, wood, and wood products. Stone, lime, cement, concrete, and their uses. Gypsum, clay, and masonry materials—how and where used. Properties, uses, care and handling of ceramics and glasses. Asbestos, mica, carbon, and asphalt composition and uses.

HAND TOOLS. Proper use, selection, care, and safety of hand tools used in the various maintenance jobs in an industrial plant. Marking and linear measurement tools. Pipe wrenches, cutters, flaring tools, reamers and special piping tools. Metal: tube and pipe benders, fish tape, cutters, wire stripping to and special electrical hand tools. Glazing, cement and ding patching tools. Woodworking and sheet metal tools. As of jigs, fasteners, clamps, and miter boxes are explained from a practical, on-the-job viewpoint.

PORTABLE POWER TOOLS. The uses, selection, and care, with special emphasis on safety and proper application is explained. Portable electric power tools — portable pneumatic power tools. Drills, sanders, grinders, saws, impact wrenches, chipping hammers, metal saws and cutting wheels. Operating characteristics of both rotating and reciprocating portable power tools are covered to provide a more sound knowledge in proper use of safe power tools in maintenance work.

PLANT SAFETY. Safe work habits, safety equipment, safe dress, fire protection and prevention, using tools safely, quality from the ground up, the right tool. OSHA — blueprint for safety. Correct lifting, carrying, climbing and descending. Understanding the building structure and warning signals, keeping your area clean for safety. Safety around revolving and reciprocating machinery, why power drives can be dangerous. Safety around pressure operated equipment, check rules to follow. Electrical hazards and OSHA standards. Instant first aid—what to do, what not to do, and life-saving techniques.

DEVELOPING TROUBLESHOOTING SKILLS. Approaching a problem — sensible, problem symptoms and common sense, responsibility, and keeping people informed. Knowing the plant equipment, maintenance records, and their value. Energy, energy sources, and the characteristics of energy. Sensing, gas sensing, and control devices and their value in problem solving. Introduction to material handling equipment and packaging systems. Motors and power transfer. Basic mechanical mechanisms. Electronics applications in industry, automation, and interrelated operations in industrial plants.

HOW POWER PLANTS WORK. This new unit is an ideal introduction to the complexities of modern power plant operation. It teaches in easily understood language, exactly how power plants work. Trainees learn how fuel is converted to steam and how steam is converted to electricity, one of our most precious commodities. Trainees quickly become familiar with power plant operating principles and maintenance requirements, even about fuels, water and wastes. They acquire the basic knowledge required to perform their jobs more effectively. And, most important of all, everyone completing this self-study program will have a better understanding of the tremendous problems faced by utilities in this age of concern over fuel shortage and environmental contamination.

WELDING PRINCIPLES. Explains the fundamentals of fusion welding. Trainees learn to identify the types of welds and weld parts. Butt, lap, tee, corner and edge welds are thoroughly illustrated and described. The common requirements of joint design and fitup, and the safe setup and operation of both gas and arc welding equipment is described in detail. Special and standard welding techniques are explained and clearly illustrated. Trainees successfully completing this easily understood unit of study will avoid most common weld faults and problems.

GAS WELDING PRACTICES. Teaches how oxyacetylene gas welding equipment is used to weld both ferrous and nonferrous metals. Numerous clear, easy-to-understand illustrations simplify the learning process. Procedures, equipment and techniques are described in detail. Flame cutting and carbon arc are thoroughly covered. The differences and similarities between the gas fusion welding process and the processes of brazing or braze welding are carefully explained. Trainees learn how and where thermal spray coating should be applied. Trainees successfully completing this unit will be thoroughly familiar with all the main oxyfuel maintenance

See accompanying Questionnaire

Introduction to Industrial Maintenance

6	Penn-Dixie Steel Kokomo
6	E S B Inc. Logansport
50%	General Tire & Rubber Logansport
3	Stockely Van Camp Tipton
200	Delco Kokomo
2	Torx Products Rochester
217	

Electrical Maintenance

6	Cabot Corp. Stellite Division Kokomo
15	Penn-Dixie Steel Kokomo
1	Star Glove Co. Kokomo
1	Kingston Division Kokomo
3	Switches Inc. Logansport
8	Krause Milling Co., Logansport
5	E S B Inc. Logansport
90%	General Tire & Rubber Logansport
2	Stokely Van Camp Tipton
3	U.S. Gypsum Wabash
40	Delco Kokomo
15	Libby's Kokomo
3	Torx Products Rochester
102	

Mechanical Maintenance

18		Cabot Corp. Stellite Division Kokomo
1		Star Glove Co. Kokomo
3		Switches Inc. Logansport
8		Krause Milling Logansport
3		E S B Inc. Logansport
	60%	General Tire & Rubber Co. Logansport
3		Stokely Van Camp Tipton
4		U.S. Gypsum Wabash
40		Delco Kokomo
3		Torx Products Rochester
83		

gp

EXHIBIT 2

GENERAL EDUCATION DEVELOPMENT TABLE FOR
MACHINIST TRADES FROM ENTRY LEVELS TO ADVANCED LEVELS FOR PARTICIPATING INDUSTRIES*

INDIANA VOCATIONAL TECHNICAL COLLEGE REGION 05

LEVEL	REASONING DEVELOPMENT	MATHEMATICAL DEVELOPMENT	LANGUAGE DEVELOPMENT
6	Apply principles of logical or scientific reasoning to define problems, collect data, establish facts and draw valid conclusions. Interpret an extensive variety of technical instructions, in books manuals, and mathematical or diagrammatic form. Deal with several abstract and concrete variables.	Perform ordinary arithmetic, algebraic geometric and calculus procedures in standard practical applications - with a thorough usable knowledge of machine shop applied mathematics as appears in the Machinist Handbook - Ed. 20. and demonstrate mathematical comprehension in use of machine tool measuring instruments at advanced machinist competency level.	Comprehension and expression of a level to: Interpret mechanical manuals as well as drawing and specifications, such as layouts, blueprints, and semantics and full use and knowledge of the Machinist Handbook for the machinist trades.
5	Apply principles of rational systems (machine trades) to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. Interpret a variety of instructions furnished in written, oral, diagrammatical or schedule form.	Perform ordinary arithmetic, algebraic, and geometric procedures and applied calculus tables as they appear in Machinist Handbook 20th - and use this level of mathematical knowledge in use of machine tool measuring instruments at intermediate machinist competency level.	Comprehension and expression of a level to set up equipment for executing a parts specification use of the Machinist Handbook under supervision.
4.	Apply common sense understanding to carry out instructions furnished in written, oral, or diagrammatic form. Deal with problems involving several concrete variables in or from standardized situations.	Use arithmetic to add, subtract, multiply, and divide whole numbers as they appear in the Machinist Handbook 20th Edition and apply this knowledge in use of machine tool measuring instruments at this operational level.	Learn job duties from written or oral instruction or demonstration.

LEVEL	REASONING DEVELOPMENT	MATHEMATICAL DEVELOPMENT	LANGUAGE DEVELOPMENT
3	Apply common sense understanding to carry out detailed but uninvolved written or oral instructions. Deal with problems involving a few common variables in or from standardized situations.	Apply knowledge of basic arithmetic processes in machine control and simple measuring instruments assigned in this job. Thorough knowledge of machine nomenclature.	Learn job duties from oral instruction or demonstration.
1-2	Apply common sense understanding to carry out one or two step instructions. Deal with standardization situations with occasional or no variables in or from these situations encountered on the job.	Perform simple addition and subtraction, reading and copying of figures, or counting and recording. Limited knowledge of machine nomenclature to job station.	Learn job duties from repeated demonstration.

* This table explains the specific vocational preparation time required to learn the techniques, acquire information and develop the faculty needed for average performance in specific job-worker machinists trades offered through the consortia project at the Logansport Training Center with its participating industries.

The following is an explanation of the various levels of specific vocational preparations:

LEVEL	TIME
1	Short demonstration only
2	Anything beyond short demonstration up to and including 30 days
3	Over thirty days up to and including 3 months
4	Over 3 months up to and including 6 months
5	Over 6 months up to and including 1 year
6	Over 1 year up to and including 2 years

PHYSICAL DEMANDS

1 - Strength (Lift, carry, push, pull)

Maximum lift 100 lbs. Frequent lift/carry over 50 lbs.

WORKING CONDITIONS

Inside (75% or more), noise and vibration

EXHIBIT 3

OCCUPATIONAL SERVICES
CAREER OPPORTUNITY CENTER

Person MALE Company _____ Testing Date 2-17-81

PERCENTILE

	10	20	30	40	50	60	70	80	90	100
Shop Arithmetic						71%				
Arithmetic for Metal Workers						60%				
Mechanical Comprehension						60%				
Mechanical Work						76%				
Computational Math					54%					

ENTRY LEVEL FOR SKILLED WORK TRAINING

Summary - Comment:

OCCUPATIONAL SERVICES
CAREER OPPORTUNITY CENTER

Person FEMALE Company _____ Testing Date 2-17-81

PERCENTILE

	10	20	30	40	50	60	70	80	90	100
Shop Arithmetic						79%				
Arithmetic for Metal Workers						62%				
Mechanical Comprehension						65%				
Mechanical Work						80%				
Computational Math						60%				

ENTRY LEVEL FOR SKILLED WORK TRAINING

Summary - Comment:

OCCUPATIONAL SERVICES
CAREER OPPORTUNITY CENTER

Person MALE Company CHRYSLER Testing Date 3-3-80

PERCENTILE

	10 20 30 40 50 60 70 80 90 100
Shop Arithmetic	0%
Arithmetic for Metal Workers	11%
Mechanical Comprehension	10%
Mechanical Work	51%
Computational Math	17%

ENTRY LEVEL FOR SKILLED WORK TRAINING

Summary - Comment:

OCCUPATIONAL SERVICES
CAREER OPPORTUNITY CENTER

Person FEMALE Company CHRYSLER Testing Date 3-3-80

PERCENTILE

	10 20 30 40 50 60 70 80 90 100
Shop Arithmetic	21%
Arithmetic for Metal Workers	22%
Mechanical Comprehension	40%
Mechanical Work	36%
Computational Math	36%

ENTRY LEVEL FOR SKILLED WORK TRAINING

Summary - Comment:

EXHIBIT 4

IVY TECH RELATED INSTRUCTION RECORD

NAME _____ APPRENTICE ____ EIT X MALE ____ FEMALE ____ SKILL CUTTER GRINDER

SS# _____ ENTRY DATE _____ DATE COMPLETED _____

COURSE NO.	SUBJECT FIRST: Gr.( )	EN.	SEN	REC	GR.
8203	Technical Math I				

COURSE NO.	SUBJECT SECOND: Gr.( )	EN.	SEN	REC	GR.
7510	Basic Drafting				
7511	Intermediate Drafting				

COURSE NO.	SUBJECT THIRD: Gr.( )	EN.	SEN	REC	GR.
5004A	Bench Work				
5568B	Bench Work				
2531A	Lubrication				
2222	Shapers & Slotters				
3560A	Cylindrical Grinding				
3560B	Cylindrical Grinding				
	MACHINIST HANDBOOK				

	FOURTH Gr.( )				
3501	Layout				
3500A	Measuring Instruments				
3500B	Measuring Instruments				
5023	Fund of Grinding				
5348	Grinding Practice				
3522C	Milling Machines				
	MACHINIST HANDBOOK				

	FIFTH: Gr.( )				
5567	Geometry & Trig				
5049	Tool Grinding				
3194	Tool Dressing				
3520C	Lathes				
2213	Turret Lathe Tools				
5809B	Measuring Instruments				
	MACHINIST HANDBOOK				

	SIXTH: Gr.( )				

	SEVENTH Gr.( )				

	EIGHT: Gr.( )				

	NINTH: Gr.( )				

	TENTH Gr. ( )				

PERSON STARTING SECOND QUARTER

IV II V I III

PERSON STARTING THIRD QUARTER

NAME _____ (EN) Enrolled Month/Year; (SEN) Exam Sent Month/Day; (REC) Exam Received Month/Day

IVY TECH RELATED INSTRUCTION RECORD

NAME _____ APPRENTICE ____ EIT X MALE ____ FEMALE ____ SKILL MACHINE REPAIR

SS# _____ ENTRY DATE _____ DATE COMPLETED _____

COURSE NO.	SUBJECT FIRST: Gr.( )	EN.	SEN	REC	GR.
8203	Technical Math I				

COURSE NO.	SUBJECT SECOND: Gr.( )	EN.	SEN	REC	GR.
7510	Basic Drafting				
7511	Intermediate Drafting				

COURSE NO.	SUBJECT THIRD: Gr.( )	EN.	SEN	REC	GR
2606	Mech. Power Transmiss.				
2602	Bearings & Seals				
2531A	Lubrication				
2531B	Lubrication				
3500A	Measuring Instruments				
3500B	Measuring Instruments				
LAB	MACHINIST HANDBOOK				

	FOURTH Gr.( )				
5567	Geometry & Trig				
6426A	Prin. of Mechanics				
6426B	Prin. of Mechanics				
2530A	Pumps				
2530B	Pumps				
6569A	Transfer Devices				
LAB	MACHINIST HANDBOOK				

	FIFTH: Gr.( )				
2539A	Hydraulics & Pneumatics				
2539B	Hydraulics & Pneumatics				
2539C	Hydraulics & Pneumatics				
2539D	Hydraulics & Pneumatics				
2539E	Hydraulics & Pneumatics				
2626A	Air Compressors				
LAB	Equipment Familarization				

	SIXTH: Gr.( )				

	SEVENTH Gr.( )				

	EIGHT: Gr.( )				

	NINTH: Gr.( )				

	TENTH Gr. ( )				

PERSON STARTING SECOND QUARTER

	II	I
IV	V	III

PERSON STARTING THIRD QUARTER

NAME _____ (EN) Enrolled Month/Year; (SEN) Exam Sent Month/Day; (REC) Exam Received Month/Day

IVY TECH RELATED INSTRUCTION RECORD

NAME _____ APPRENTICE X EIT _____ MALE _____ FEMALE _____ SKILL MACHINE REPAIR

SS# _____ ENTRY DATE _____ DATE COMPLETED _____

COURSE NO.	SUBJECT FIRST: Gr.( )	EN.	SEN	REC	GR.
8203	Technical Math I				

COURSE NO.	SUBJECT SECOND: Gr.( )	EN.	SEN	REC	GR.
8208	Geometry				
8209	Trigonometry				

COURSE NO.	SUBJECT THIRD: Gr.( )	EN.	SEN	REC	GR.
7510	Basic Drafting				
7511	Intermediate Drafting				

	FOURTH Gr.( )				
2222	Shapers & Slotters				
5023	Fund of Grinding				
5348	Grinding Practice				
3521A	Drilling				
3521B	Drilling				
6569A	Transfer Devices				
LAB	MACHINIST HANDBOOK				

	FIFTH: Gr.( )				
3522A	Milling Machines				
3522B	Milling Machines				
3522C	Milling Machines				
2217	Milling Machine Pract.				
2218	Indexing & Spiral Work				
2607A	Belt Power Transmiss.				
LAP	MACHINIST HANDBOOK				

	SIXTH: Gr.( )				
2606	Mech. Power Transmiss.				
2602	Bearings & Seals				
2531A	Lubrication				
2531B	Lubrication				
3500A	Measuring Instruments				
3500B	Measuring Instruments				
LAB	MACHINIST HANDBOOK				

	SEVENTH Gr.( )				
2560A	Engineer Mechanics				
2560B	Engineer Mechanics				
2560C	Engineer Mechanics				
2560D	Engineer Mechanics				
2530A	Pumps				
2530B	Pumps				
LAB	MACHINIST HANDBOOK				

	EIGHT: Gr.( )				
2539A	Hydraulics & Pneumatics				
2539B	Hydraulics & Pneumatics				
2539C	Hydraulics & Pneumatics				
2539D	Hydraulics & Pneumatics				
2539E	Hydraulics & Pneumatics				
2626A	Air Compressors				
LAB	MACHINIST HANDBOOK				

	NINTH: Gr.( )				
3520A	Lathes				
3520B	Lathes				
3520C	Lathes				
3520D	Lathes				
3520E	Lathes				
2243	Gear Calculations				
LAB	Equipment Familarization				

	TENTH Gr. ( )				
2446	Gearing				
2604	Gear Trains				
5532A	Gear Making				
5532B	Gear Making				
2603	Link Mechanisms				
2605	Cams				
LAB	Troubleshooting				

PERSON STARTING SECOND QUARTER

PERSON STARTING THIRD QUARTER

		I
III	II	VI
IV	V	IX
VII	VIII	X

NAME _____ (EN) Enrolled Month/Year; (SEN) Exam Sent Month/Day; (REC) Exam Received Month/Day

IVY TECH RELATED INSTRUCTION RECORD

NAME _____ APPRENTICE X EIT _____ MALE _____ FEMALE _____ SKILL MODEL MAKER

SS# _____ ENTRY DATE _____ DATE COMPLETED _____

COURSE NO.	SUBJECT FIRST: Gr.( )	EN.	SEN	REC	GR.
8203	Technical Math I				

COURSE NO.	SUBJECT SECOND: Gr.( )	EN.	SEN	REC	GR.
8208	Geometry				
8209	Trigonometry				

COURSE NO.	SUBJECT THIRD: Gr.( )	EN.	SEN	REC	GR.
7510	Basic Drafting				
7511	Intermediate Drafting				

	FOURTH Gr.( )				
5349	Tool Grinding				
3522A	Milling Machines				
3522B	Milling Machines				
3522C	Milling Machines				
2217	Milling Mach Practice				
2218	Indexing & Spiral Work				
	MACHINIST HANDBOOK I				

	FIFTH: Gr.( )				
3520A	Lathes				
3520B	Lathes				
3520C	Lathes				
3520D	Lathes				
3520E	Lathes				
5809B	Measuring Instruments				
	MACHINIST HANDBOOK II				

	SIXTH: Gr.( )				
5021A	Metal Cutting				
2222	Shapers & Slotters				
5004A	Bench Work				
5568B	Bench Work				
3500A	Measuring Instruments				
3500B	Measuring Instruments				
	MACHINIST HANDBOOK III				

	SEVENTH Gr.( )				
5654A	Plastics				
5654F	Plastics				
5654G	Plastics				
5654H	Plastics				
5099	Jigs & Fixtures				
5100	Jig & Fixture Making				
7532	TOOL DRAFTING				

	EIGHT: Gr.( )				
5098	Gage Making				
2540A	Tool Making				
2540B	Tool Making				
2540C	Tool Making				
5101A	Dies & Die Making				
5101B	Dies & Die Making				
7555	MOLD DESIGN DRAFTING				

	NINTH: Gr.( )				
5023	Fund of Grinding				
5348	Grinding Practice				
3521A	Drilling				
3521B	Drilling				
5041	Numerical Control				
3194	Tool Dressing				
7557	JIG & FIXTURE DES DRAFT				

	TENTH Gr. ( )				
	SPECIAL PROJECT				

PERSON STARTING SECOND QUARTER

PERSON STARTING THIRD QUARTER

		I
III	II	VI
IV	V	IX
VII	VIII	X

NAME _____ (EN) Enrolled Month/Year; (SEN) Exam Sent Month/Day; (REC) Exam Received Month/Day

IVY TECH RELATED INSTRUCTION RECORD

NAME _____ APPRENTICE X EIT _____ MALE _____ FEMALE _____ SKILL TOOL & DIE MAKER

SS# _____ ENTRY DATE _____ DATE COMPLETED _____

COURSE NO.	SUBJECT FIRST: Gr.( )	EN.	SEN	REC	GR.
8203	Technical Math I				

COURSE NO.	SUBJECT SECOND: Gr.( )	EN.	SEN	REC	GR.
8208	Geometry				
8209	Trigonometry				

COURSE NO.	SUBJECT THIRD: Gr.( )	EN.	SEN	REC	GR.
7510	Basic Drafting				
7511	Intermediate Drafting				

	FOURTH Gr.( )				
5349	Tool Grinding				
3522A	Milling Machines				
3522B	Milling Machines				
3522C	Milling Machines				
2217	Milling Mach Practice				
2218	Indexing & Spiral Work				
	MACHINIST HANDBOOK I				

	FIFTH: Gr.( )				
3520A	Lathes				
3520B	Lathes				
3520C	Lathes				
3520D	Lathes				
3520E	Lathes				
5809B	Measuring Instruments				
	MACHINIST HANDBOOK II				

	SIXTH: Gr.( )				
5021A	Metal Cutting				
2222	Shapers & Slotters				
5004A	Bench Work				
5568B	Bench Work				
3500A	Measuring Instruments				
3500B	Measuring Instruments				
	MACHINIST HANDBOOK III				

	SEVENTH Gr.( )				
2560A	Engineer Mechanics				
2560B	Engineer Mechanics				
2560C	Engineer Mechanics				
2560D	Engineer Mechanics				
5099	Jigs & Fixtures				
5100	Jig & Fixture Making				
7532	TOOL DRAFTING				

	EIGHT: Gr.( )				
5098	Gage Making				
2540A	Tool Making				
2540B	Tool Making				
2540C	Tool Making				
5101A	Dies & Die Making				
5101B	Dies & Die Making				
7533	DIE DRAFTING				

	NINTH: Gr.( )				
5023	Fund of Grinding				
5348	Grinding Practice				
3521A	Drilling				
3521B	Drilling				
5041	Numerical Control				
3194	Tool Dressing				
7557	JIG & FIXTURE DES DRAFT				

	TENTH Gr. ( )				
	Special Project				

PERSON STARTING SECOND QUARTER

PERSON STARTING THIRD QUARTER

		I
III	II	VI
IV	V	IX
VII	VIII	X

NAME _____ (EN) Enrolled Month/Year; (SEN) Exam Sent Month/Day; (REC) Exam Received Month/Day

IVY TECH RELATED INSTRUCTION RECORD

NAME _____ APPRENTICE____ EIT X MALE ____ FEMALE ____ SKILL TOOL & DIE MAKER

SS# _____ ENTRY DATE _____ DATE COMPLETED_____

COURSE NO.	SUBJECT FIRST: Gr.( )	EN.	SEN	REC	GR.
8203	Technical Math I				

COURSE NO.	SUBJECT SECOND: Gr.( )	EN.	SEN	REC	GR.
7510	Basic Drafting				
7511	Intermediate Drafting				

COURSE NO.	SUBJECT THIRD: Gr.( )	EN.	SEN	REC	GR.
5021A	Metal Cutting				
2222	Shapers & Slotters				
5004A	Bench Work				
5568B	Bench Work				
3500A	Measuring Instruments				
3500B	Measuring Instruments				
	MACHINIST HANDBOOK III				

	FOURTH Gr.( )				
5567	Geometry & Trig				
5349	Tool Grinding				
2217	Milling Mach Practice				
2218	Indexing & Spiral Work				
5099	Jigs & Fixtures				
5100	Jig & Fixture Making				
7532	TOOL DRAFTING				

	FIFTH: Gr.( )				
5098	Gage Making				
2540A	Tool Making				
2540B	Tool Making				
2540C	Tool Making				
5101A	Dies & Die Making				
5101B	Dies & Die Making				
7533	DIE DRAFTING				

	SIXTH: Gr.( )				

	SEVENTH Gr.( )				

	EIGHT: Gr.( )				

	NINTH: Gr.( )				

	TENTH Gr. ( )				

PERSON STARTING SECOND QUARTER

	II	I
IV	V	III

PERSON STARTING THIRD QUARTER

NAME _____ (EN) Enrolled Month/Year; (SEN) Exam Sent Month/Day; (REC) Exam Received Month/Day

IVY TECH RELATED INSTRUCTION RECORD

NAME _____ APPRENTICE ____ EIT X MALE ____ FEMALE ____ SKILL INSPECTION-GAGE CRIB CHECK

SS# _____ ENTRY DATE _____ DATE COMPLETED _____

COURSE NO.	SUBJECT FIRST: Gr.( )	EN.	SEN	REC	GR.
8203	Technical Math I				

COURSE NO.	SUBJECT SECOND: Gr.( )	EN.	SEN	REC	GR.
8208	Geometry				
8209	Trigonometry				

COURSE NO.	SUBJECT THIRD: Gr.( )	EN.	SEN	REC	GR.
7510	Basic Drafting				
7511	Intermediate Drafting				

	FOURTH Gr.( )				
3500A	Measuring Instruments				
3500B	Measuring Instruments				
2590	Quality Control				
2608A	Mechanical Testing				
2608B	Mechanical Testing				
5809B	Measuring Instruments				
	MACHINIST HANDBOOK I				

	FIFTH: Gr.( )				
5098	Gage Making				
5011	Chemistry				
5110	Metallurgy of Iron				
5111	Metallurgy of Steel				
3195	Hardening & Tempering				
5962	Inspection of Products				
	MACHINIST HANDBOOK II				

	SIXTH: Gr.( )				

	SEVENTH Gr.( )				

	EIGHT: Gr.( )				

	NINTH: Gr.( )				

	TENTH Gr. ( )				

PERSON STARTING SECOND QUARTER

PERSON STARTING THIRD QUARTER

III II I

IV V

NAME _____ (EN) Enrolled Month/Year; (SEN) Exam Sent Month/Day; (REC) Exam Received Month/Day